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Seawater Desalination for the City of Long Beach

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Presentation Outline

- **Long Beach Overview**
- **Planning Approach**
- **Water Quality Concerns**
- **Conclusion**

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Long Beach Water Department

- California's 5th most populous city (480,000 people)
- 70,000 AF of drinking water per year
- 5,500 AF of reclaimed water per year
- Operate largest GW treatment plant in US
- 912 miles of drinking water lines
- 763 miles of sewer lines

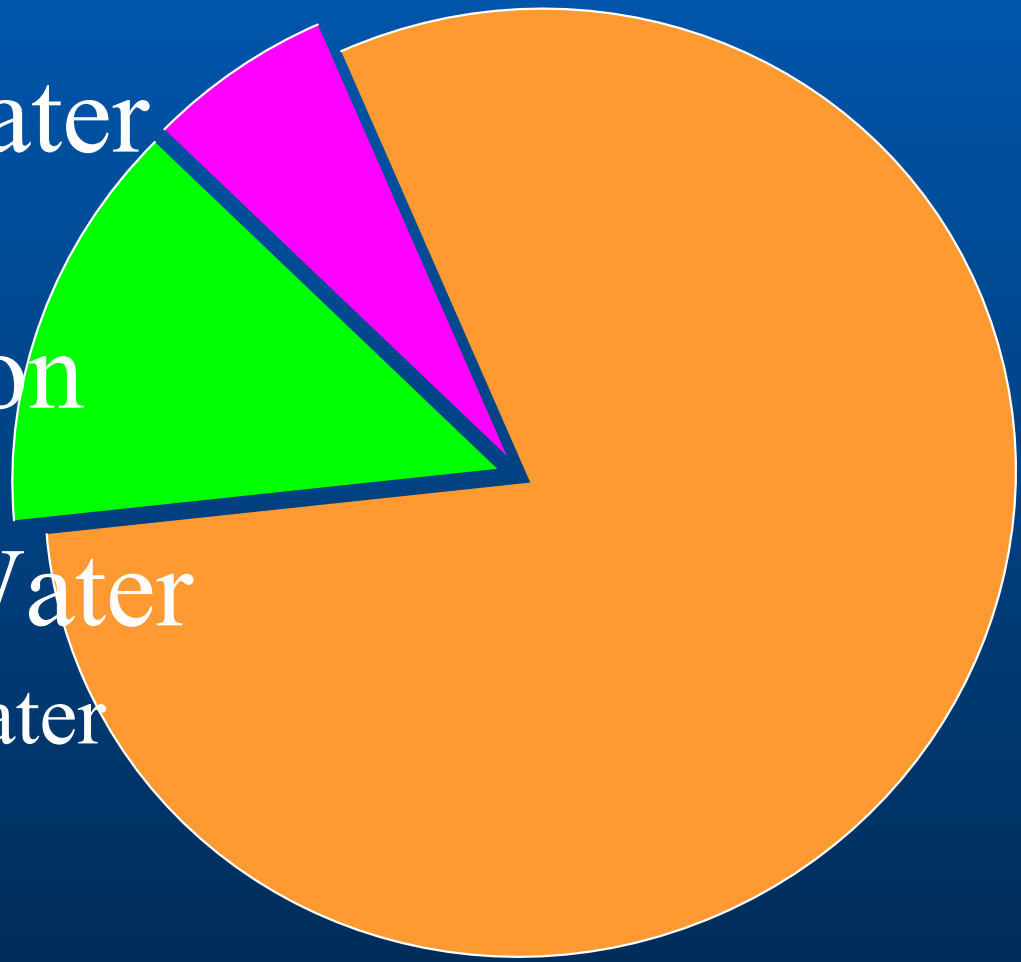
Long Beach Water Department

6%: Recycled Water

14%: Conservation

80%: Drinking Water

- -46% LB Groundwater
- -54% Imported



Imported Water Supply

Los Angeles Aqueduct:
~37% reduction

California Aqueduct:
~No Increase

Colorado River Aqueduct:
~50% reduction

…communities must produce more water locally to manage new limits on imports and growth in southern California's population and economy.

Future Reliability

- Very little population growth
- Expansion of recycled water and water conservation
- Seawater desalination necessary ==> supplement City's imported drinking water supply

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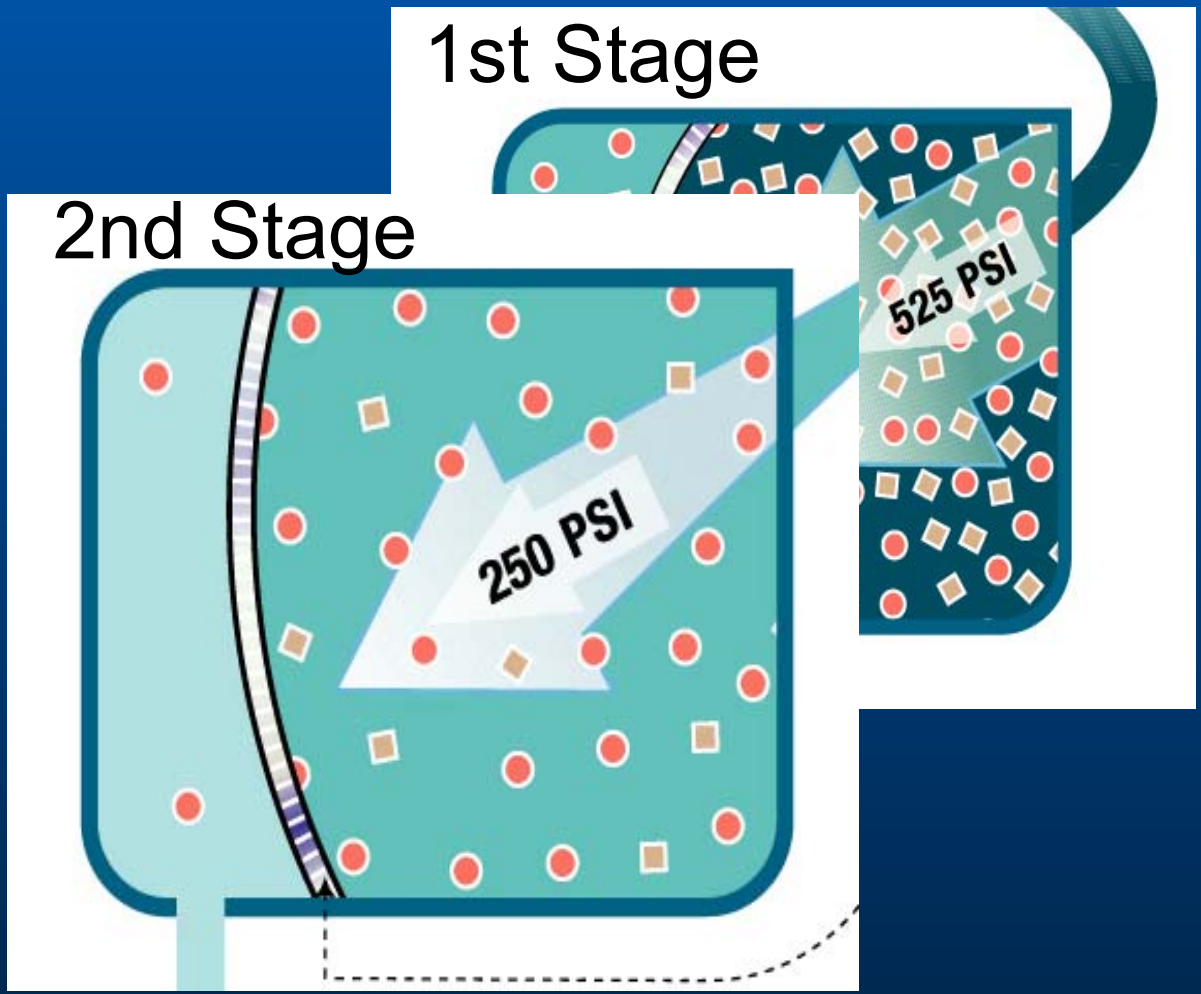
Planning: Integration

	"Traditional"	Community Based
Plant Size	•15 to 50+ MGD	•5 to 15 MGD
Source Water	•Power plant cooling water	•May be independent
Brine Disposal	•Large volumes (combine with cooling water discharge)	•Smaller volumes = additional options
Distribution Infrastructure	•Regional pipelines and pump stations (possible wheeling costs)	•Existing retail distribution system
Control/Own	•Conform with power plant pumping schedule	•Independent control

Planning: Process Development

- Patent pending 2-staged process



- Energy savings
  - **Lower pressure requirements ==> Lower energy consumption**
- Quality protection
  - **Two physical barriers**

Planning: Program Development

A 3-Phased Seawater Desalination Program

① **Pilot Plant** (continuing)

② **Prototype** (currently in design)

③ **Production Plant** (~2010)

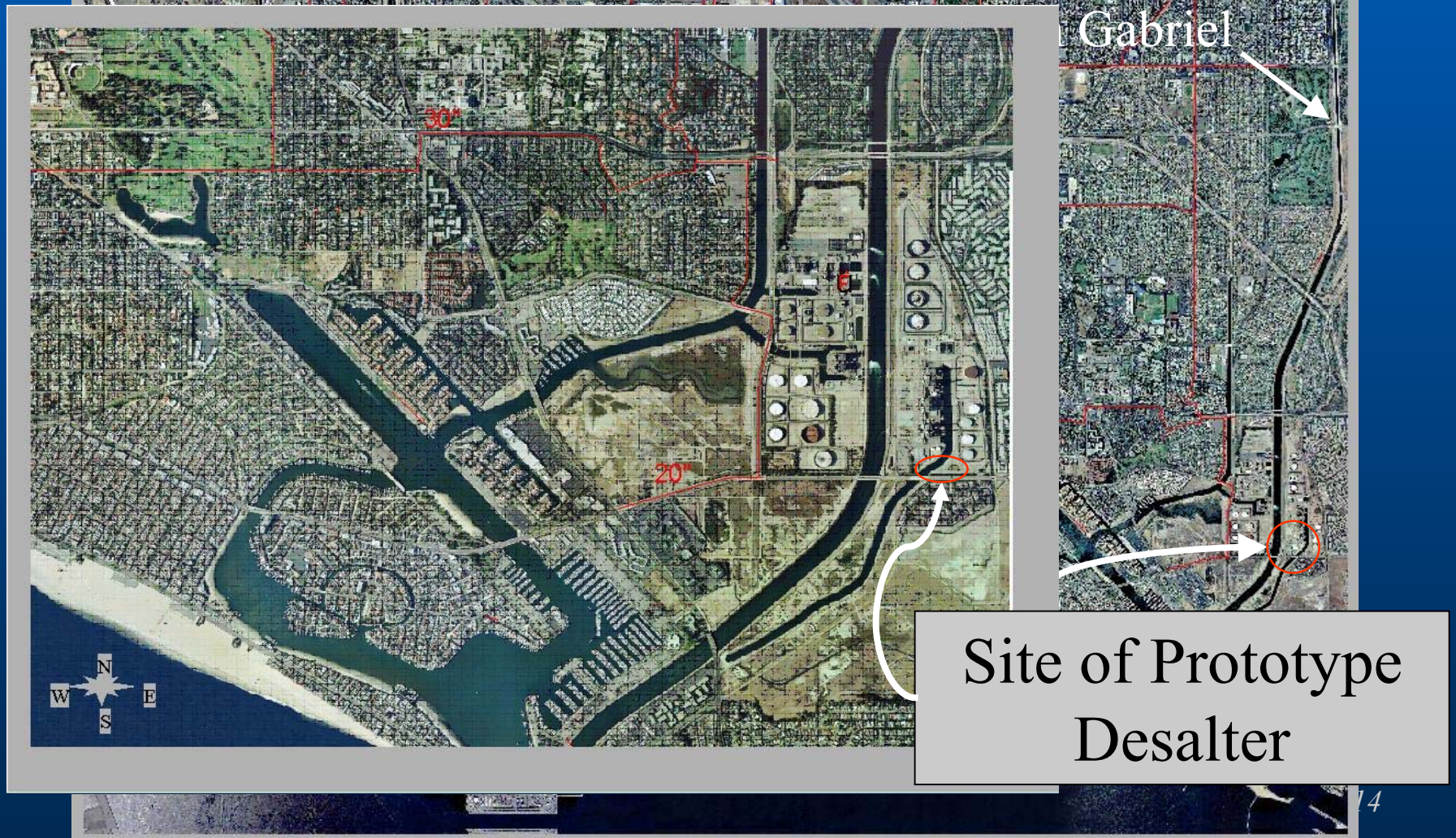
Phase 1: Pilot Plant

-9,000 gpd Pilot Plant
-In operation since 2001
-Applied research, 2-stage nanofiltration
* Energy consumption
* Water quality
* Optimum configuration
* Etc.

Phase 2: Prototype Plant

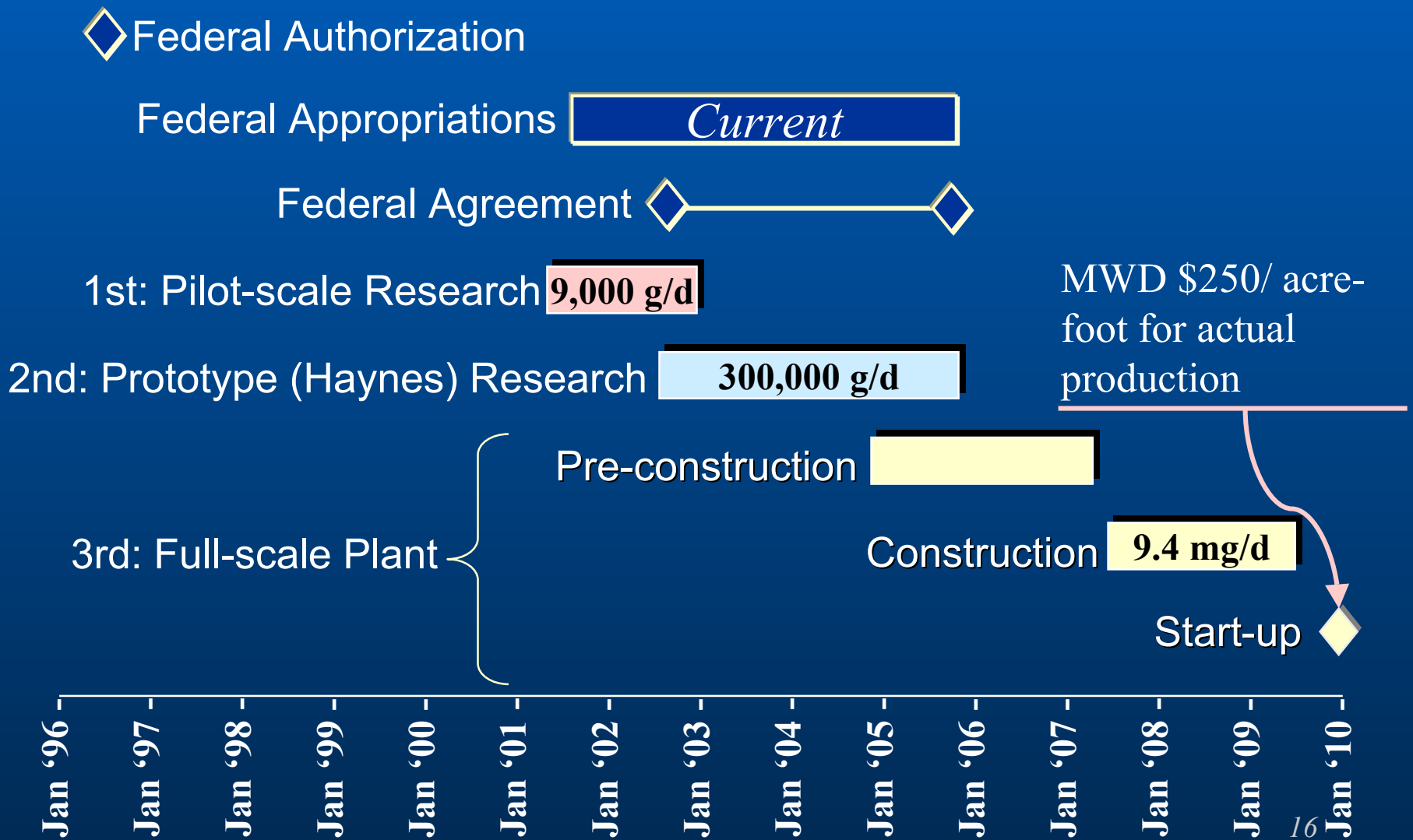
- 300,000 gpd (product water) Prototype Plant
- Partnership:USBR & LADWP
- Develop accurate information on capital and operating costs
- Develop information needed for permitting large-scale desalter
- Optimize Asst. General Manager Diem Vuong's 2-stage Nanofiltration process
- Refine Community-based desalination model

Phase 2: Prototype Plant Site



Phase 3: Potential Locations

Planning: Schedule



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Water Quality Concerns

- **Standard operating conditions:**

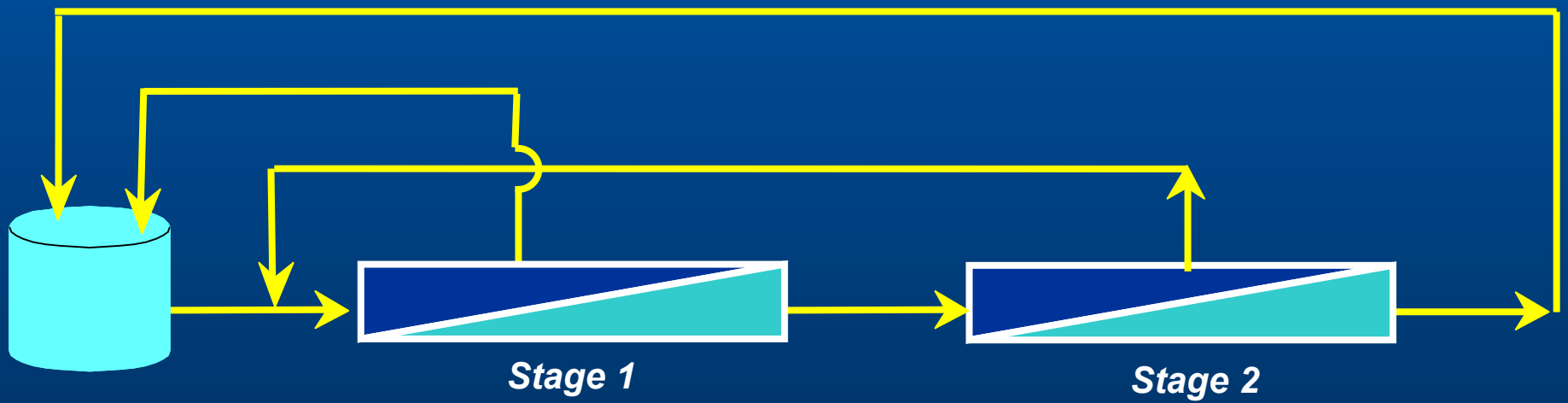
	Raw Water	Permeate
TDS	~ 34,500 mg/L	~ 150 mg/L
Bromide	~ 62 mg/L	0.4 - 0.6 mg/L

Boron: Background

- Typically < 1 mg/L in surface waters
- Naturally occurring in seawater (~4.5 mg/L)
- Toxic to some common trees (0.5 - 1.0 mg/L)
- Show reproductive health effect in animals
- CDHS established an Action Level at 1 mg/L
- No USEPA “MCL” but is on EPA radar
- WHO guideline at 0.3 mg/L (original)
- WHO revised guideline to 0.5 (treatment limitation)
- Difficult to remove by membranes

Boron Removal

- **Traditional single-pass SWRO achieves 40% - 60% rejection**
- **LBWD's NF2 Process**



B = 4.6 mg/L

B = 3.7 mg/L

B = 2.4 mg/L

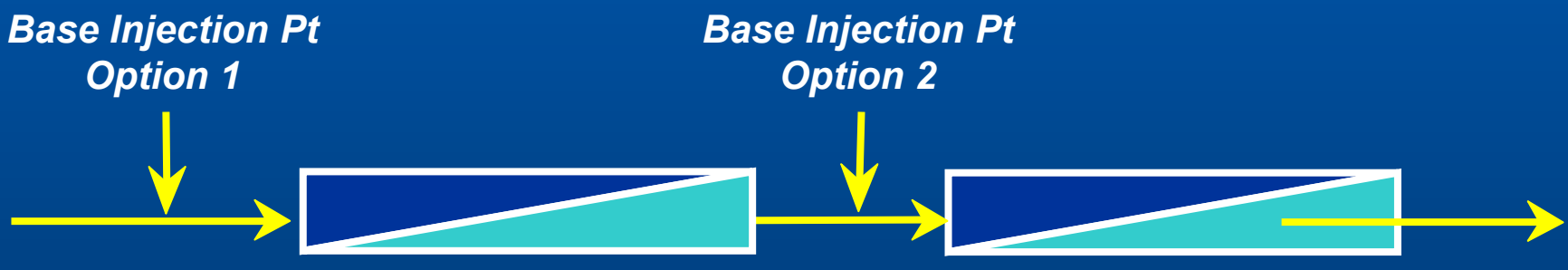
Stage 1 Rejection ~ 20%

Stage 2 Rejection ~ 35.1%

Overall Rejection ~ 48%

Boron Removal Strategy

- **Boron rejection can be improved by increasing pH**



$\overline{Alk}$ = 122 mg/L

$\overline{Ca^{2+}}$ = 447 mg/L

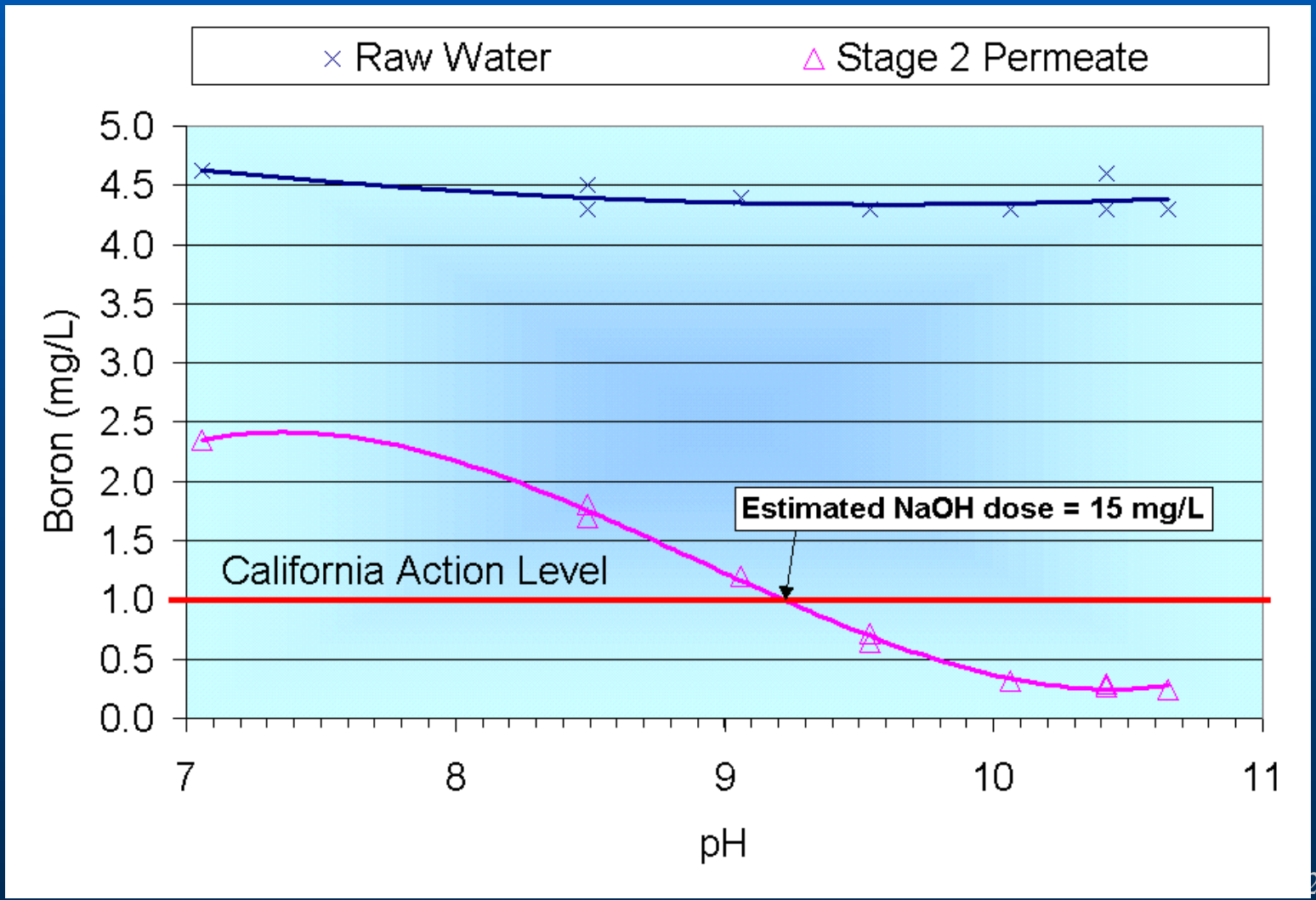
- *More base required to alter pH*
- *HIGH potential for fouling*

$\overline{Alk}$ = 10.4 mg/L

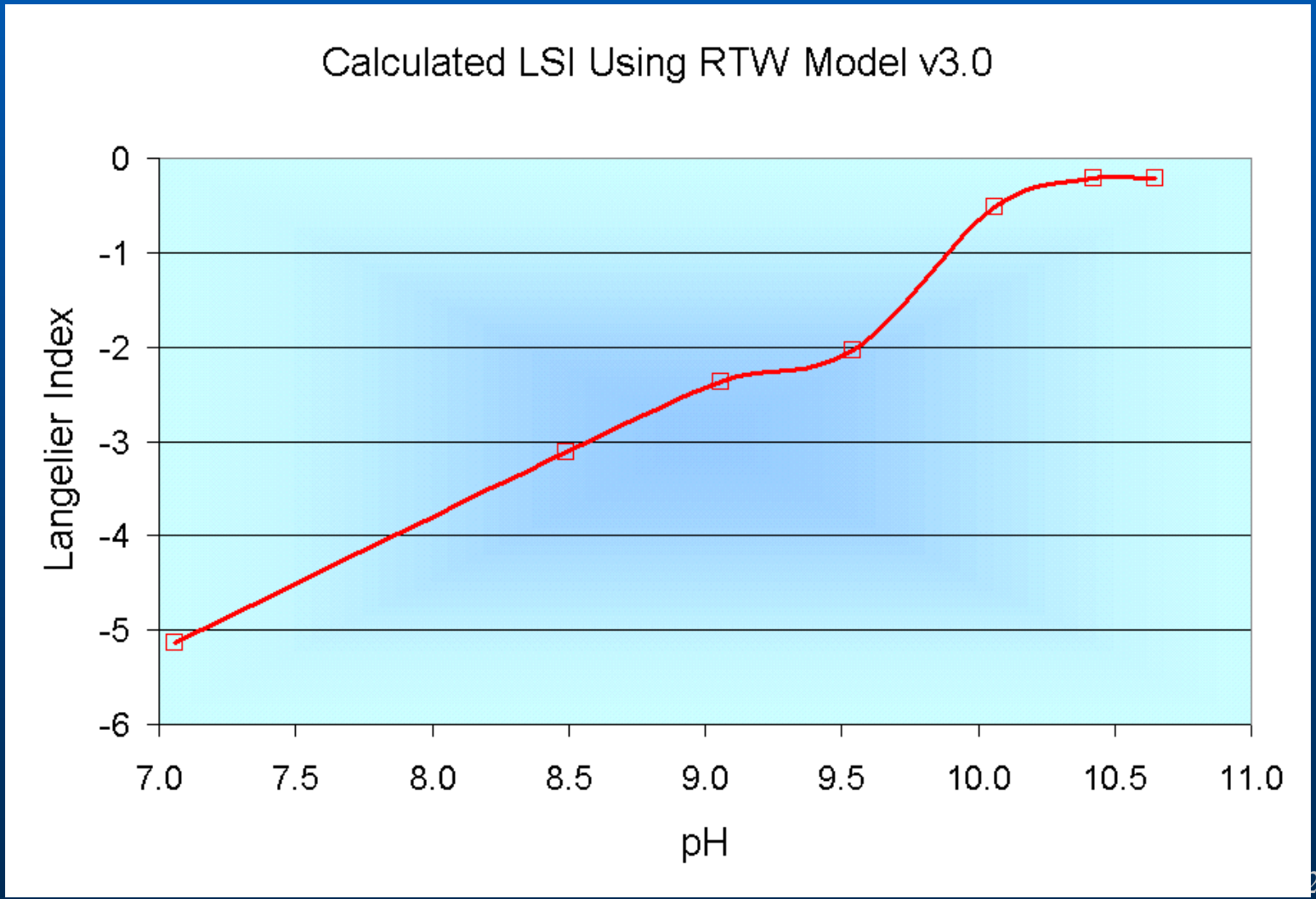
$\overline{Ca^{2+}}$ = 11.7 mg/L

- *Less base required to alter pH*
- *97% rejection of Ca^{2+}. Decreased potential for fouling*

Boron Removal Results



Boron Removal Results (cont.)



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Conclusions

- **Water Supply**
  - **Strong dependence on imported water. Need to improve reliability**
- **Planning**
  - **Community based model**
  - **Using a 3-phased program to develop desalination**
- **Water Quality Strategy**
  - **General WQ parameters consistent with single-pass SWRO**
  - **Verified cost efficient boron removal strategy that is unique to 2-stage processes**

Acknowledgement

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  - Diem Vuong, Assistant General Manager
  - Dr. Robert Cheng, Director of Water Quality
  - Matt Lyons, Manager of Planning
  - Tai Tseng, Senior Civil Engineer